

GRADUATE STUDENTS' CONCEPTIONS OF THE TENURE-TRACK HIRING
PROCESS IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH FIELDS

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ABSTRACT

Women have long been underrepresented in science, technology, engineering, and math (STEM) fields. Factors including gender, marital and parental status, and gendered adjectives used in letters of recommendation have been linked to women's success in STEM fields. Many graduate students studying in STEM fields are preparing for academic careers, and it is unclear if their preferences when making a tenure-track hiring decision would match those of faculty. In the study described here, graduate students in STEM fields were asked to rate and rank three hypothetical candidates applying for a tenure-track position in their department. The candidates' gender, marital and parental status, gendered adjectives and persona, and history of parental leave were varied across participants. Overall, participants preferred the candidate described with female adjectives and persona, and participants in math-intensive fields were less likely to prefer a female candidate. Candidate's history of parental leave did not affect participants' preferences.

BIOGRAPHICAL SKETCH

Rachel Sumner completed her Bachelor of Arts in Psychology at William Smith College in 2008. She is pursuing her PhD in developmental psychology at Cornell University.

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Introduction

Women in science, technology, engineering and math (STEM) fields have made impressive gains in recent decades, but they continue to grapple with issues that disproportionately affect their gender. In academic STEM fields, underrepresentation of women becomes more severe as one continues along the career path. Many studies have examined facets of the hiring process, such as the effect of applicant's gender (e.g., Steinpreis, Anders, & Ritzke, 1999) and letters of recommendation (Madera, Habl, & Martin, 2009), and facets of work and family life that may affect women in STEM more so than men, such as marital status (Perna, 2001) and parental status (Mason & Goulden, 2002).

Graduate students in STEM fields, many of whom aspire to a career in academia (Golde & Dore, 2004), have often been left out of this kind of research. The study presented here asks graduate students from biology, economics, engineering, and psychology to make hypothetical tenure-track hiring decisions and measures the impact of the job applicant's gender, marital status, parental status, and gendered descriptors on students' hiring decisions. The goal of this study is to see what kind of tenure-track job applicants are preferred by graduate students, who are not normally involved in this hiring process. Asking students whom they would hire is one way of assessing what skills and experiences graduate students think are valuable in the tenure-track hiring process; given that doctoral programs vary widely in the extent to which they provide formal preparation for academic job searching, with many providing no systematic guidance at all (Austin, 2002), graduate students' preferred attributes may differ significantly from those valued by faculty hiring committees.

Women in STEM fields

Women's representation in STEM varies widely by field, and in many fields their representation decreases as one advances along the professional pipeline: In 2010, women received only 53.7% of bachelor's degrees in social sciences (47.4% of doctoral degrees), 59% of bachelor's degrees in biological sciences (52.9% of doctoral degrees), 18.4% of bachelor's degrees awarded in engineering (23.2% of doctoral degrees), and 77.1% of bachelor's degrees in psychology (70.3% of doctoral degrees). In non-science and engineering fields, this common pattern of increasing underrepresentation does not emerge: women receive 60.4% of bachelor's degrees (60.5% of doctoral degrees) (National Science Foundation, 2013).

Jobs in STEM fields are desirable for many reasons, one of which is their relatively high pay (median annual income of \$70,000 for women, \$85,000 for men) compared to non-science and engineering jobs (median annual income of \$51,000 for women, \$78,000 for men) (National Science Foundation, 2013). In recent years, more women are reporting that having a high paying career is important to them, and this is especially true for young adults: among those aged 18 to 34, more women than men report that succeeding in a high paying profession is important to them (Patten & Parker, 2012). This focus on a high paying career may make STEM jobs particularly attractive to individuals who are currently in college or graduate school. Efforts to increase women's success in these high paying careers are ongoing, while researchers keep identifying potential reasons for women's continued underrepresentation in STEM fields (see Ceci, Williams, & Barnett, 2009 for a review).

In academic STEM careers, men currently outnumber women in research faculty (66.62% compared to 33.38%) and teaching faculty (67.41% compared to 32.59%) positions. This difference in representation is much smaller when looking at adjunct faculty positions, however (56.06% men, 43.93% women) (National Science Foundation, 2013). Why are women

so underrepresented in research and teaching faculty positions? One reason may be that they are seriously outnumbered when applying for these kinds of jobs: A recent study of tenure-track searches in STEM fields at a research university found that only 15.2% of job applicants were women (Glass & Minnotte, 2010). Other research has looked at gendered language in letters of recommendation, with one study finding that communal characteristics (more often used to describe female applicants) were negatively related to hirability (Madera, Habl, & Martin, 2009), and another study that failed to find a difference in the gendered language used in letters of recommendation for men and women (Ledin, Bornmann, Gannon, & Wallon, 2007). Research on hiring decisions has also yielded mixed results: Steinpreis, Anders, and Ritzke (1999) found that equally qualified female candidates were less likely to be hired than their male counterparts, but Glass and Minnotte (2010) found that female applicants have a better rate of success than men when it comes to getting hired. In data collected from 63 tenure-track job searchers at one university, 4.28% of female applicants were hired and only 2.03% of male applicants were hired. Even if women are actually at an advantage for getting hired when they apply to a tenure-track position in a STEM field, there are too few female applicants for that advantage to ameliorate their overall underrepresentation.

Once hired, there continue to be gender differences in STEM fields. Both women and men faculty are more likely to discuss research with male colleagues (Holleran, Whitehead, Schmader, & Mehl, 2011), some research has found that women authors are at a disadvantage when trying to publish in a journal that uses a single-blind review process (Budden et al., 2008; cf: however, Ceci & Williams, 2011, for counterevidence), and women faculty report spending more time on undergraduate instruction, which is related to decreased average yearly publications and presentations, than men (Carrigan, Quinn, & Riskin, 2011; though, again, there

is counterevidence showing both genders devote comparable time to teaching; NRC, 2009; Davis, 2009). Female faculty working in a department that had a critical mass of women (at least 15%) spent significantly less time on undergraduate instruction than those in a department without a critical mass of women faculty. Carrigan and colleagues (2011) also found that female faculty working in a department with a critical mass of women reported higher career satisfaction and salary, which may be seen as another reason to recruit and retain more women in academic STEM fields.

Given current levels of women's underrepresentation in STEM fields, women who do work in these fields have to contend with some of the psychological consequences of being a numerical minority in a male-dominated profession. Many studies have demonstrated that negative effects are associated with minority status, such as decrements to academic and task performance, especially when one's identity is made salient in a given situation (e.g., Steele & Aronson, 1995). Women who stay in STEM fields despite such identity threats may be less affected by them. Indeed, a recent study by Richman and vanDellán (2011) found that female students from relatively gender balanced fields (e.g., sociology) expressed less interest in attending a conference if they were shown a promotional video that included a majority of males and masculine activities, whereas female engineering students' interest in attending was unaffected by the gender composition of the video. It remains unclear whether such a reaction to being a numerical minority is the result of individual differences such as personality traits, or chronic exposure to such situations. There can also be negative repercussions of numerical minority status: Female professors in STEM fields report distancing themselves from other women, specifically those exemplifying stereotypically feminine traits, those who claim to experience barriers because of their gender, and those who "do not make strategic choices

regarding career and family” (Rhoton, 2011, pg. 706). This distancing is one way of dealing with the task of trying to succeed in a male-dominated field, but it may be disadvantageous for other women as it perpetuates ideas about success in STEM fields and feminine identity being mutually exclusive.

A “motherhood penalty”

As was found in the Rhoton (2011) study mentioned above, women may be treated differently by co-workers as a result of their choices related to family life. In studies looking at hypothetical white-collar job scenarios, mothers were rated as being less competent than females without children and they were less likely to be considered for promotion, hiring, or additional job training (Correll, Benard, & Paik, 2007; Cuddy, Fiske, & Glick, 2004; Heilman & Okimoto, 2008). One follow-up study revealed that female parents, compared to male parents and applicants without children, were rated as the least likely to engage in agentic behavior (e.g., be a leader, think independently), which mediated ratings of competence (Heilman & Okimoto, 2008).

Research suggests that women in academic STEM fields are particularly affected by this potential conflict between work and family desires and demands. In a survey of over 30,000 junior faculty, women were less likely than male faculty to have a tenure-track position, be married, or have at least one child (Jacobs & Winslow, 2004; Perna, 2001), all of which suggests that women, more so than men, are making a trade-off between work and family. This trade-off may be unacceptable to some women: Many married women with children (59% in one study) say that they are considering leaving academia (Mason & Goulden, 2002).

There is less evidence suggesting that men in academic STEM fields are making similar work and family trade-offs: Women faculty are more likely to say that they have fewer children

than they wanted (38%, compared to 18% of men) (Mason & Goulden, 2004), and in the sciences, 50% of women and 30% of men do not have at least one child in the household 12-14 years after completing their PhD (Mason & Goulden, 2002). Ecklund and Lincoln's (2011) survey of 3,455 scientists found roughly twice as many women as men claiming career demands caused them to have fewer children than desired, which was associated with lower career satisfaction. Perna (2001) found that women who were married had higher odds of being in a part-time, non-tenure track job compared to unmarried women, but marital status had no relationship to male's employment status. When asked their reason for working part time, 52.40% of women scientists and engineers cite family responsibilities as at least one reason (compared to 15.96% of men scientists and engineers working part time) (National Science Foundation, 2013).

For faculty who become parents within 5 years of completing a PhD, there are career consequences that differentially affect men and women. Males who have an "early baby" are much more likely to get tenure than females who have an early baby. Women who have a baby more than 5 years after getting their PhD and women who never have children have about the same rate of getting tenure, which is higher than the rate for women with early babies (Mason & Goulden, 2002). Perhaps this is due to actual differences between fathers and mothers; for example, married men with children are much more likely to work 60 or more hours per week than married women with children (42.1% and 28.7%, respectively) (Jacobs & Winslow, 2004). On the other hand, different career consequences related to parenthood could be due to perceived (and not actual) differences between male and female parents; one recent study found that the supervisors of faculty perceive differences between mothers and fathers in terms of work involvement and flexibility for advancement above and beyond what mothers and fathers

themselves report (King, 2008). Such discrepancies between the success of male and female parents may prompt some women to delay parenthood until after getting tenure, but this is not a realistic option for most female faculty since the average age of a female assistant professor in STEM fields is 43.7 years, which is past the prime childbearing years (Jacobs & Winslow, 2004; see Williams & Ceci, 2012, for a review).

Graduate students in STEM fields

As might be expected, a number of themes emerge when asking students about their experience in graduate school. Specifically, support, self-direction, ambiguity, and transition were common themes mentioned by doctoral students in STEM (e.g., math, electrical engineering) and non-STEM (e.g., English, communication) fields (Gardner, 2010a). Doctoral students in chemistry and history reported experiencing ambiguity in terms of research and how to prepare for the job market (Gardner, 2007), and doctoral students in a science program were more likely to mention difficulty during the transition from student to independent researcher than were their counterparts in a humanities program (Gardner, 2008).

Many graduate students are interested in obtaining a faculty position (at least at some point in their career) (Gold & Dore, 2004), so one would expect that graduate programs are effective at preparing their students for academic job searches and careers. Surveys of graduate students suggest that this is not the case: 43% of students who were interested in a faculty position agreed that their program is preparing them to publish and 45% of students said they had the opportunity to take on “progressively more responsible roles in research projects” (Golde & Dore, 2004, pg. 23). The process of socializing graduate students into their academic field is usually informal, with most of the information about necessary skills for success coming from a student’s advisor or peers (Gardner 2007, Gardner 2008, Gardner 2010a; Gardner, 2010b). The

likelihood of a department offering formal workshops on the academic job search varies widely (Golde & Dore, 2004), which may explain why so many students report feeling unprepared for the tasks they'll be required to do in a full- or part-time academic career (Austin, 2002).

Given the reported experience of ambiguity and the relative lack of formal socialization related to academic job searches and careers, it would be reasonable to ask what skills and experiences graduate students think are valued in academic positions, and how their expectations align with those of faculty members who actually make decisions about hiring and tenure. One way to get at this issue would be to ask graduate students to make hypothetical hiring decisions, enabling one to see whether attributes such as an applicant's gender and teaching experience affect their hiring decisions. The majority of graduate students who want to pursue a career as a professor report being motivated by their enjoyment of teaching (Golde & Dore, 2004) and institutional rhetoric usually emphasizes the importance of high-quality teaching (Austin 2002). Institutional reward structures (such as tenure) and observations of how faculty actually spend their time, however, conflict with the message that teaching is an important part of succeeding in academia (Austin, 2002). Indeed, although recent research suggests that graduate students' teaching experiences can bolster their research skills (Feldon et al., 2011), psychology professors rated the ability to establish an independent research program (not teaching) as the most important quality that an applicant would need in order to get hired, followed by personality factors and then the prospect for collaboration (Steinpreis, Anders, & Ritzke, 1999). It would be reasonable to expect that graduate students might think that teaching ability is more highly valued in the tenure-track hiring process than it actually is.

Although many graduate students may plan to pursue an academic career when beginning their graduate program, experiences in graduate school often lead to changes in students' career

aspirations. Lack of realistic expectations about faculty life, in addition to concerns about balancing work and family, cause many graduate students to leave their PhD programs before completion (Golde, 2005). In a survey of postdoctoral scholars and doctoral students, a career as a tenure-track professor in the sciences was seen as the least family friendly (compared to non-tenure track positions or jobs outside of a research-intensive university) (Goulden, Mason, & Frasch, 2011) and more than one third of graduate students report that their interest in a faculty career had declined since they began graduate school (Golde & Dore, 2004). Summarizing comments made by doctoral students who left graduate programs in geology, biology, history, or English, Golde (2005) writes, “Faculty members did not seem to have successful family lives, nor did they devote much time to this aspect of life. This concern was particularly prevalent in the sciences” (pg. 689). According to one faculty member speaking to Mason and Goulden (2004), “You should know that female graduate students are telling us over and over again across the nation that they are not going to become faculty members because they do not see how they can combine work and family in a way that is reasonable” (pg. 14). The perceived difficulties in maintaining a work-family balance in academia, especially academic science positions, can deter many graduate students from considering or pursuing this kind of career.

The Current Study

Existing research has frequently assessed professors’ preferences when it comes to academic STEM career decisions (such as hiring or promotion) (e.g., Glass & Minnotte, 2010; Madera et al., 2009; Steinpreis et al., 1999), but there is a dearth of research looking at graduate students’ conceptions of what attributes are valued in academic STEM hiring scenarios. Research with faculty has revealed that gender (Glass & Minnotte, 2010; Jacobs & Winslow, 2004; King, 2008; Steinpreis et al., 1999), parental status (Mason & Goulden, 2002; Mason &

Goulden, 2004; Perna, 2001), and stereotypically gendered adjectives used to describe an applicant (Madera et al., 2009; Trix & Psenka, 2003) can affect the likelihood of getting and succeeding in an academic STEM job. The current study uses a hypothetical hiring scenario and manipulates applicants' gender, parental status, the gendered adjectives/persona used to describe each applicant, and whether the applicant had taken a 12-month parental leave in the past, in an attempt to assess graduate students' conceptions of what traits and experiences are valuable when applying for an assistant professor position in a STEM field. The current study replicates the methodology used in a previous study conducted with faculty in STEM fields (Williams & Ceci, under review), and extends this work to a new population, namely, STEM graduate students.

The gender of job applicants was manipulated across participants in the current study. Since previous research has yielded mixed findings, with some studies showing women are less likely to be hired (e.g., Steinpreis et al., 1999) and other work showing that women are more likely to be hired (Glass & Minnotte, 2010), there was no specific hypothesis for the effect of applicant gender on participants' hiring decisions. It was hypothesized that, when choosing between two applicants who are parents, participants would prefer to hire the father instead of the mother (e.g., King, 2008). Given previous research suggesting that agentic, or stereotypically masculine, adjectives are positively related to hiring (e.g., Madera et al., 1999), it was hypothesized that participants in the current study would be more likely to hire the applicant described with masculine adjectives/persona than the applicant described with feminine adjectives/persona. Analyses will also be conducted to see if participants who are in more math-intensive fields are less likely to hire female applicants, those described by feminine adjectives

and persona, or those who had taken a 12-month parental leave, and if female and male participants differ in their hiring decisions.

Method

Participants. An email inviting individuals to participate in this study was sent to graduate students in biology, economics, engineering, and psychology programs across the country. These particular STEM fields were chosen because two are social sciences (economics, psychology) and two are natural sciences/engineering (biology, engineering). Also, two of the fields are math-intensive (economics, engineering) and the other two are less math-intensive (biology, psychology). Finally, two are fields in which women are well-represented (biology and psychology) and two are not (economics and engineering). Potential participants were chosen from the top 100 programs in each field (as determined by online rankings) and the email addresses of randomly selected students in those programs were gathered from departments' online directory sites. When information about program type (PhD or Master's degree) was available, PhD students were chosen since they are more likely to pursue a career in academia.

In total, 1040 students were emailed with an invitation to participate. Of those emailed, 238 participants (51.7% female) responded with complete data, seven people responded declining to participate, and 10 people responded but didn't provide data, yielding a 24.5% response rate. The vast majority of participants were currently in a PhD program (95.2%).

Materials. Each participant read brief descriptions of three hypothetical candidates (Dr. X, Dr. Y, and Dr. Z) for an assistant professor position. Dr. Y was included as a foil who was slightly less published than the other two candidates. Across conditions, we varied candidate gender (male, female), gendered adjectives/persona used to describe the candidate (masculine

adjectives/persona, feminine adjectives/persona), candidate's lifestyle (single, no kids; married, no kids; married with two children and stay-at-home spouse; married with two children and a spouse who works outside the home), and whether the candidate is described as having taken a 12-month parental leave during his/her career (took 12-month leave, has not taken 12-month leave). Table 1 shows descriptions of each of the 10 conditions used in this study, and sample descriptions of Drs. X, Y, and Z can be found in Appendix A. (See Williams & Ceci, under review, for a description of the development of these materials.)

Procedure. Each participant was sent an email describing the study as an investigation of “what types of applicants are most hireable” for tenure-track faculty positions. Participants were asked to imagine that they were on their department's search committee tasked with filling an assistant professor position. They were provided with descriptions of three hypothetical candidates for the position, described as the “search committee chair's notes.” Participants were asked to evaluate each candidate on a scale from 1 (cannot support) to 10 (truly extraordinary/exceptional) and rank each candidate (#1 (best), #2 (2nd best), #3 (3rd best)). They were also asked to provide some information about themselves (e.g., year in graduate school, if they've served on a search committee before).

Those who chose to participate returned their ratings, ranking, and information via email. Some participants were compensated for their participation with a \$10 or \$20 online gift card.

Results

The conditions used in this study can be divided into two groups: Those that ask participants to choose between two equally qualified candidates, one a woman and one a man (conditions 1, 2, and 3), and those that ask participants to choose between two equally qualified

same-sexed candidates, one who has taken a 12-month parental leave and one who has not (conditions 4 and 5). Since these differences lead to distinct research questions, the two groups of conditions were analyzed separately using chi-square tests to test for differences in participants' preferences for applicants. The "hiring decision" made by each participant is reflected in their #1 ranked applicant: Whichever applicant was ranked #1 is considered to be the applicant that would have been hired by that participant. Only six participants ranked candidate Y (the foil) as #1, and they were not included in any of the following analyses. Chi-square tests were conducted using SPSS.

Conditions 1-3: Choosing between an equally qualified female and male

Overall in conditions 1-3, there was not a significant difference in the rate at which male and female candidates were ranked #1. Female applicants were preferred by 52.4% of participants, and male applicants were preferred by 47.6% of participants, $\chi^2(1) = .34, p = .56$. Looking at hiring decisions by participants' gender, 59.5% of female participants preferred the female applicant, and 44.9% of male participants preferred the female applicant, $\chi^2(1) = 3.02, p = .08$.

These same hiring decisions (overall by applicant gender, and applicant gender by participant gender) were tested using chi-square analyses within each of the four STEM fields represented in this sample, and no significant differences emerged. The rate at which female applicants were preferred did not significantly differ from the rate at which male applicants were preferred within any field, and the rate at which male and female participants preferred the female applicant didn't differ within fields. Comparing different types of fields (social sciences (economics and psychology) vs. natural science and engineering (biology and engineering)) also failed to reveal significant differences in the rate at which female applicants were preferred.

When math-intensive fields (economics and engineering) are compared to less math-intensive fields (biology and psychology), however, significant differences emerge: 42.6% of participants in math-intensive fields preferred the female applicant, whereas 61.3% of participants in less math-intensive fields preferred the female applicant, $\chi^2(1) = 4.99, p = .03$.

Hiring decisions by applicant gender and applicant gender by participant gender were also examined within lifestyle conditions. In conditions 1A and 1B (both applicants single, no kids), 55.1% of participants preferred the female applicant and 44.9% of participants preferred the male applicant, $\chi^2(1) = .51, p = .48$. Female participants in these conditions preferred the female applicant 57.7% of the time, and male participants preferred the female applicant 52.2% of the time, $\chi^2(1) = .15, p = .70$. In conditions 2A and 2B (both applicants married, no kids), female and male applicants were hired at the same rate (50%), $\chi^2(1) = 0.0, p = 1.0$. Female participants preferred the female applicant 60% of the time, and male participants preferred the female applicant 40% of the time, $\chi^2(1) = 1.60, p = .21$. Finally, in conditions 3A and 3B (both applicants married, with 2 children and a stay-at-home spouse), the female applicant was preferred 51.9% of the time and the male applicant was preferred 48.1% of the time, $\chi^2(1) = .07, p = .79$. Among female participants, 60.7% preferred the female applicant, and 42.3% of male participants preferred the female applicant, $\chi^2(1) = 1.83, p = .18$.

The relationship between applicant lifestyle and participant's field was also examined as related to hiring decisions. In conditions 1A and 1B, there was no significant difference in the hiring patterns by specific field: The female applicant was preferred 54.5, 45.5, 50.0, and 66.7% of the time in biology, economics, engineering, and psychology respectively, $\chi^2(3) = 1.35, p = .72$. The relationship between applicant gender and participant field was also not significant in conditions 2A and 2B. Female applicants were preferred 50.0, 54.5, 42.9, and 50.0% in biology,

economics, engineering, and psychology respectively, $\chi^2(3) = .23, p = .97$. In conditions 3A and 3B, with applicants who were both described as being married with 2 children and a stay-at-home spouse, there was a significant difference in hiring decisions between fields. Female applicants were preferred by 78.6% of participants from biology, 43.8% of participants from engineering, and 61.5% of participants in psychology, but only 18.2% of participants in economics, $\chi^2(3) = 9.91, p = .02$.

The gendered adjectives/persona used to describe each candidate were also manipulated. Within each lifestyle condition (e.g., single, no kids), some participants were given descriptions of the applicants whose gender matched the adjectives and persona they were described with (male applicant described by male adjectives/persona, female applicant described by female adjectives/persona) and the other participants read descriptions of applicants whose gender was incongruent with the adjectives and persona used to describe them (male applicant described by female adjectives/persona, female applicant described by male adjectives/persona). Overall, participants were more likely to prefer the applicant who was described with female adjectives and persona (71.6% compared to 28.4%), $\chi^2(1) = 43.10, p < .001$. This was true for female participants (68.9% preferred the candidate described by female adjectives/persona), $\chi^2(1) = 10.60, p = .001$, and male participants (72.5% preferred candidate described by female adjectives/persona), $\chi^2(1) = 13.93, p < .001$. The relationship between participant gender and gendered adjectives/persona of participant's top candidate was not significant, $\chi^2(1) = .06, p = .80$. Looking at the relationship between hiring decisions and applicants' gender/adjective match, most of the female applicants who were preferred (68%) had adjectives that did match their gender, but most of the male applicants who were preferred (73.5%) had adjectives that didn't match their gender, $\chi^2(1) = 24.63, p < .001$.

Conditions 4 and 5: Same gender applicants, one of whom has taken a parental leave

In these conditions, participants chose between two candidates of the same gender, both married with two children and a spouse who works outside the home, but one applicant had taken a 12-month parental leave and one had not.

There was no significant difference between the number of participants who preferred the applicant who had taken a parental leave (49.4%) and those who preferred the applicant who had not taken a parental leave (50.6%), $\chi^2(1) = .01, p = .92$. The relationship between participant gender and hiring decision was also not significant: 50% of female participants preferred the applicant who had taken leave and 48.8% of male participants preferred the applicant who had taken leave, $\chi^2(1) = .01, p = .91$.

Looking at the relationship between hiring decisions and gendered adjectives/persona used to describe the applicants in these conditions, 73% of participants preferred the candidate who was described with female adjectives/persona and 27% of participants preferred the applicant described by male adjectives/persona, $\chi^2(1) = 18.89, p < .001$. When broken down by participant gender this difference remains significant (72.1% of male participants hired the applicant described by female adjectives/persona, $\chi^2(1) = 8.40, p = .004$; 73.9% of female participants hired the applicant described by female adjectives/persona, $\chi^2(1) = 10.52, p = .001$). For neither female nor male participants was there a significant relationship between the gendered adjectives/persona and applicant's history of parental leave.

Discussion

In this study, graduate students in STEM fields were asked to make hypothetical hiring decisions. Previous research using a similar design and faculty participants found that male

applicants were preferred to female applicants (Steinpreis et al., 1999), but several analyses of actual hiring decisions have reported that, when they applied for a tenure track position in STEM fields, female applicants were more likely to be hired than male applicants by a 2-to-1 ratio (e.g., Glass & Minnotte, 2010). The present research found that, when presented with equally qualified applicants for an assistant professor position, there was no significant difference in the rate at which the female and male applicants were preferred by graduate students across all STEM fields, although female participants were marginally more likely than male participants to prefer the female applicant ($p = .08$). There was a significant difference between math-intensive STEM fields and less math-intensive fields, however: participants in math-intensive fields were less likely to prefer the female applicant compared to participants in less math-intensive fields.

Perhaps the finding that graduate students equally preferred male and female applicants (across STEM fields) differs from existing work showing a preference for male job applicants (e.g., Steinpreis et al., 1999) because the climate in which today's graduate students operate is one in which equality and representation of women in science are often discussed; it is likely that these issues were less salient during graduate school for tenured and tenure-track faculty who are making hiring decisions now. If current graduate students cultivate and maintain a commitment to equality throughout their careers, then that could possibly help bolster women's increasing representation in STEM fields.

The marital and parental status of the hypothetical applicants in general did not affect participants' preferences either. When choosing between an equally qualified woman and man, each of whom was single with no kids or married with no kids, there was no significant difference between the rate at which the female applicant was preferred and the male applicant was preferred. This lack of significant difference held when looking at all participants, male and

female participants separately, and within participants' field of study. When choosing between equally qualified candidates, both married with two children and a stay-at-home spouse, there was no significant difference between the rate at which the female and male candidates were preferred overall or when looking at male and female participants separately, but there was a significant effect when looking at participants' field: participants in economics were less likely to prefer the female candidate in this condition than participants in either biology, engineering, or psychology. Economics was chosen as a field to include in this study because it is a social science that is quite math-intensive and in which women are underrepresented, and previous research has shown that the extent to which a STEM field is heavily quantitative is related to women's representation in that field (Ceci & Williams, 2011).

Another factor that could affect hiring in STEM fields is parental leave. Since the signing of the Family and Medical Leave Act in 1993, parental leave has become more available to mothers and fathers in the United States (Waldfogel, 1999), but there is some question as to the potential consequences of taking a parental leave on subsequent career opportunities (e.g., Judiesch & Lyness, 1999). Participants in this study did not demonstrate a preference for candidates who had no history of parental leave, and this effect held when choosing between two female applicants or two male applicants. Many existing hiring studies have examined people's choices when choosing between a man and a woman, but investigating the choices that are made when individuals are asked to choose between equally qualified candidates, one who has taken a parental leave in the past, is a relatively novel question. As parents continue to take advantage of parental leave policies that are available to them, it is important for researchers to understand the consequences that these mothers and fathers could face as a result of this decision.

Within each condition, one of the applicants was described with female adjectives/persona and one was described with male adjectives/persona. In previous research, communal characteristics (or feminine adjectives) were negatively related to ratings of applicant's hirability (Madera et al., 2009), and some research has found that letters of recommendation for women are more likely to portray the applicant as a teacher and student whereas men's letters of recommendation more often describe the applicant as a researcher and professional (Trix & Psenka, 2003). The graduate students participating in this study overwhelmingly preferred the applicant who was described with female adjectives and persona. The gendered adjectives and persona were used to describe either a male or female applicant (depending on condition), and there was not a significant relationship between participant gender and the gendered adjectives/persona of their preferred applicant; both male and female participants preferred applicants of both genders who were described by female adjectives/persona.

This finding might be due (at least in part) to the content of the applicant descriptions used in this study. The description that included a female persona and adjectives mentioned the applicant's "impressive teaching abilities" and that he/she received a teaching award in graduate school, whereas the description including a masculine persona and adjectives made no mention of the applicant's teaching ability. This is consistent with existing research finding that letters of recommendation for women often describe them as teachers, while those for men tend to emphasize the applicant's skills as a research (Trix & Psenka, 2003). Participants in the current study were given the option to write a comment at the end of the hiring task, and many who chose to write a comment mentioned that the applicant's teaching ability affected their hiring decision.

Graduate students often receive mixed messages about the importance of teaching when it comes to succeeding in academia, noting “that statements made by institutional leaders about the importance of high-quality teaching do not coincide with the way their advisors or supervising faculty spend their time, with advice offered in casual hall conversations, or with university reward structures” (Austin, 2002, pg. 104), so they may be unclear about the importance of teaching in real-world hiring situations. Faculty members, who are responsible for making actual hiring decisions, emphasize an applicant’s ability to establish a successful program of research and potential for collaboration instead of their teaching ability (Steinpreis et al., 1999), though perhaps that view is has changed over the years and needs to be confirmed by contemporary surveys.

Although graduate students are not usually in a position to make decisions related to the hiring of tenure-track assistant professors, asking them to make hypothetical hiring decisions can shed light on their conceptions about what attributes are valued in academic STEM positions. Some graduate students do get the opportunity to participate in hiring committees, and exposure to professors’ conversations about applicants’ strengths and weaknesses may lead these graduate students align their conceptions about success with those of faculty (who ultimately decide which applicant gets hired). In this sample there were not enough graduate students who reported having participated in a hiring committee to make meaningful comparisons between them and those who have never participated in a hiring committee, but potential benefits of hiring committee participation for graduate students would be an interesting topic for future researchers to explore.

Limitations and future directions

In this study, participants were only asked to provide information about their year in graduate school (1 through 7+), the kind of program (PhD or MA), and their field. No information was collected about other factors that could be associated with students' success in graduate school and STEM fields, including: their experience with formal or informal exposure to information about what it takes to get hired in STEM departments, their experiences with mentors, the gender diversity within their department, or their teaching and research experience (Ampaw & Jaeger, 2011; Blake-Beard, Bayne, Crosby, & Muller, 2011; Feldon et al., 2011; Golde, 2005). A more comprehensive picture of factors that influence STEM graduate students' conceptions of the tenure-track hiring process could be constructed with such information.

Another limitation is the low response rate: 75.5% of graduate students who were invited to participate chose not to do so, and it could be that the study described here is not based on a representative sample. Additionally, graduate students were chosen from only four particular STEM fields, which could also raise questions of the sample's representativeness. Although these fields were specifically chosen to represent different aspects of the broad spectrum in STEM fields (e.g., life sciences, social sciences, highly quantitative, less quantitative), including students from other fields could improve our understanding of graduate students' conceptions about traits and experiences that are valuable in hiring scenarios.

Finally, the current study focused exclusively on academic hiring scenarios. Tenure-track hiring decisions are made by committees, and participants in this study were asked to rate and rank applicants alone, without input from colleagues (some of whom may have extensive hiring experience); this may be one reason that experimental studies on hiring decisions can yield results that differ from studies examining actual hiring data. Although academic careers are of interest to many graduate students (Golde & Dore, 2004), there are also many students who plan

to pursue a career outside of academia. Future research should consider hiring decisions in non-academic STEM positions, since women's underrepresentation in STEM fields extends to these professions as well.

Conclusion

The research described here is a preliminary investigation into graduate students' conceptions of what factors are valuable in acquiring an academic STEM position. Many students who are in the midst of a degree program plan to pursue an academic career, but their understanding of the qualities and experiences that make a candidate appealing to hiring committees has been relatively ignored by researchers. Overall, participants in this study tended to be unaffected by job candidates' gender, marital and parent status, and history of parental leave. This can be seen in a hopeful light, perhaps suggesting that hiring decisions made in the future (when these graduate students have become tenure-track faculty and are involved in actual hiring) will be more equitable than they have been in the past. On the other hand, this finding could reflect graduate students' ignorance about attributes that affect actual hiring decisions (e.g., the relative importance of teaching ability), suggesting that they may be in for a rude awakening upon entering the academic job market. Graduate programs vary widely in the extent to which they provide their students with information about what it takes to get hired, so more research on what graduate students know about getting hired and how they get this information would be beneficial for students, educators, employers, and researchers.

Appendix A – Sample Candidate Descriptions

Dr. X: X impressed the entire search committee as a great potential hire. Based on her vita, letters of recommendation, and their own reading of her work, the search committee rated X's research record as "extremely strong." Letter-writers especially noted that X is highly creative and original in her approach to scholarship, with comments like "X is poised to break new ground with her unique and imaginative applications of her advisor's theory, and is sure to change how people think about her research area." They also described X's impressive teaching abilities, mentioning that she was "widely considered an effective and supportive mentor by the junior graduate students and undergraduates she worked with." She also won a teaching award in graduate school. X's faculty job talk/interview score was 9.5/10. At dinner with the committee, she reached out to everyone, showing herself to be very likeable, kind, and socially skilled. During our private meeting, X was enthusiastic about our department, and there did not appear to be any obstacles if we decided to offer her the job. She mentioned that she is single with no partner/family issues. X said our department has all the resources needed for her research.

Dr. Y: Y came across during his interview/visit as a smart, serious scholar with a solid record. Based on his vita, letters of recommendation, and their own reading of his work, the committee rated his research record as "very strong." Y's letter-writers all praised the "breadth and quality of his research and ideas" and described him as a "highly desirable hire among his cohort of graduate students." They also noted that Y works on an "established set of paradigms that are sure to continue to generate publications and funding in the future." Y's faculty job

talk/interview score was 9.3/10. One issue raised by two members of the search committee is that Y is somewhat shy and reserved; thus there was some question about his ability to handle large introductory lecture courses. No one foresaw any problems with his teaching in a small-seminar context. At dinner, Y was pleasant but spoke little and was a bit hard to get to know—however, most of us felt this would resolve in time. During my private discussion with Y, he seemed enthusiastic about our department, and there did not appear to be any obstacles if we decided to offer him the job. He did not mention any partner/family issues. Y said our department has all the resources he needs for his research.

Dr. Z: Z struck the search committee as a real powerhouse. Based on her vita, letters of recommendation, and their own reading of her work, the committee rated Z's research record as "extremely strong." Z's recommenders all especially noted her high productivity, impressive analytical ability, independence, ambition, and competitive skills, with comments like "Z produces high-quality research and always stands up under pressure, often working on multiple projects at a time." They described her tendency to "tirelessly and single-mindedly work long hours on research, as though she is on a mission to build an impressive portfolio of work." She also won a dissertation award in her final year of graduate school. Z's faculty job talk/interview score was 9.5/10. At dinner with the committee, she impressed everyone as being a confident and professional individual with a great deal to offer the department. During our private meeting, Z was enthusiastic about our department, and there did not appear to be any obstacles if we decided to offer her the job. She said her husband will stay home with their two children (thus no need for university daycare). Z said our department has all the resources needed for her research.

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Table 1 – Descriptions of conditions and job candidates

Condition	Description	Dr. X	Dr. Z
1A	Candidates both single, no kids	Woman, female adjectives/persona	Man, male adjectives/persona
1B	Candidates both single, no kids	Man, female adjectives/persona	Woman, male adjectives/persona
2A	Candidates both married, no kids	Woman, female adjectives/persona	Man, male adjectives/persona
2B	Candidates both married, no kids	Man, female adjectives/persona	Woman, male adjectives/persona
3A	Candidates both married, with 2 children and a stay at home spouse	Woman, female adjectives/persona	Man, male adjectives/persona
3B	Candidates both married, with 2 children and a stay at home spouse	Man, female adjectives/persona	Woman, male adjectives/persona
4A	Both candidates are women with 2 children and a husband who works outside of the home	Woman, female adjectives/persona	Woman, male adjectives/persona, took 12-month parental leave
4B	Both candidates are women with 2 children and a husband who works outside of the home	Woman, male adjectives/persona	Woman, female adjectives/persona, took 12-month parental leave
5A	Both candidates are men with 2 children and a wife who works outside of the home	Man, female adjectives/persona	Man, male adjectives/persona, took 12-month parental leave
5B	Both candidates are men with 2 children and a wife who works outside of the home	Man, male adjectives/persona	Man, female adjectives/persona, took 12-month parental leave